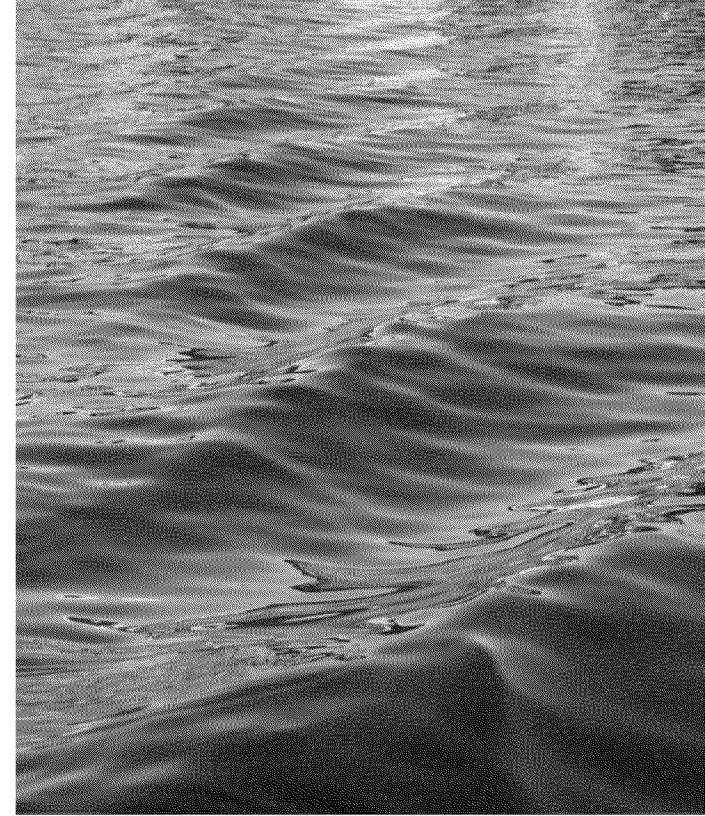


Oak Ridge Reservation: Development of Site-specific Fish Consumption Rate for Recreational Use of Bear Creek

November 30, 2021



Outline

- Objective and Overview of Technical Approach
- Technical Aspects
 - Radionuclides of interest
 - Fish Sampling Design & Fish Community Survey Results
 - Key Parameter Inputs
 - Site-specific Equations and Example Calculations
- Wrap-Up

Objective and Overview of Technical Approach

- Develop site-specific risk-based cleanup levels for radionuclides discharged from the existing landfill and proposed landfill (EMDF) into surface water for radionuclides associated with the waste streams.
 - Protect state-designated use = recreational
 - 10^{-5} risk level
 - LUCs (signage, DOE land use designations) are not considered
- Challenge: no existing promulgated standards for radionuclides (i.e., no existing state or federal AWQCs)
- A formal dispute per the Oak Ridge Federal Facilities Agreement was settled by the 12/31/21 Wheeler Decision.
- Use standard equation to develop risk-based values, substituting site-specific factors where appropriate.

Comparison of DOE, CWA and CERCLA Parameters

Two deviations from Office of Water guidance (other parameters consistent with OW guidance)

Combined 8-
fold
difference

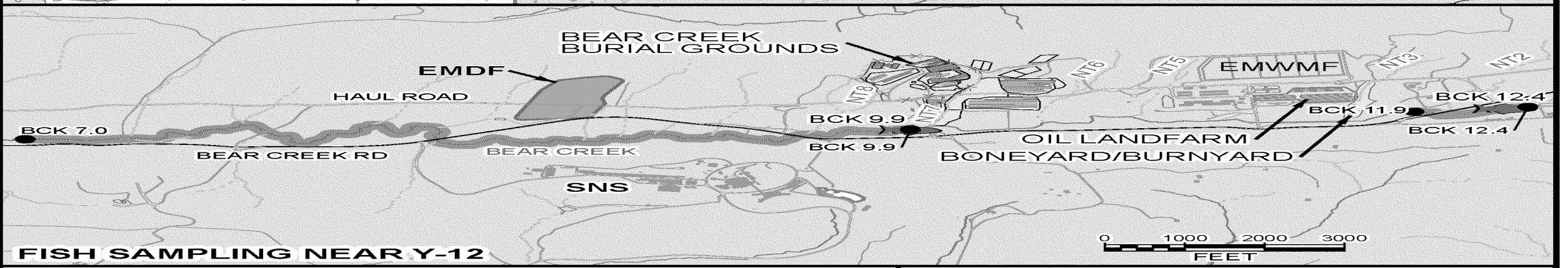
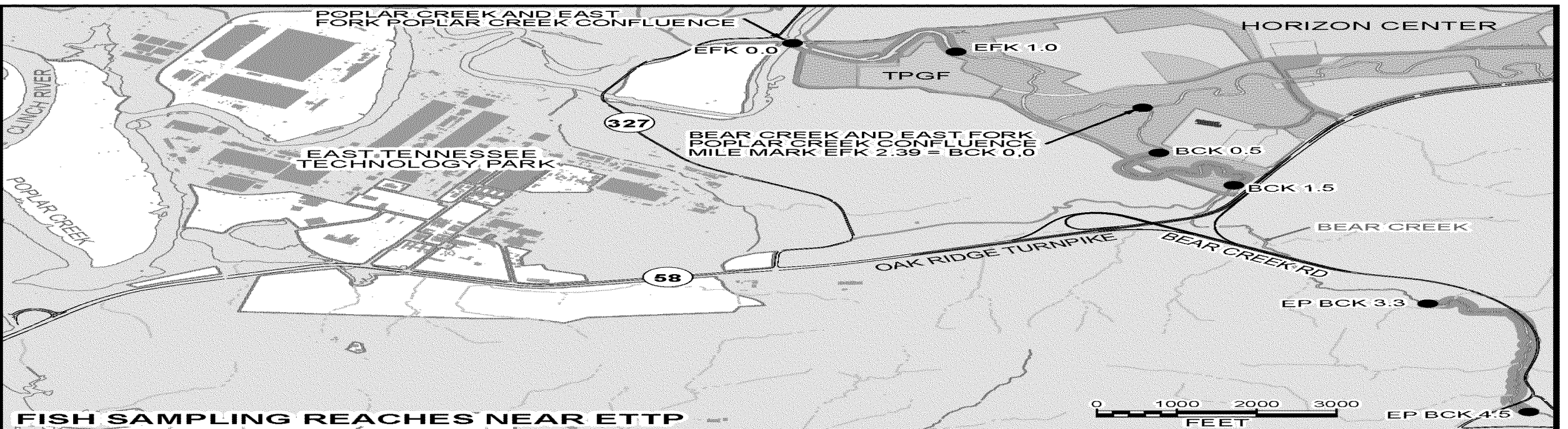
Variable	DOE Method		EPA CWA Method		EPA CERCLA Method	
Variable	Value	Source	Value	Source	Value	Source
Target Risk (TR), unitless	1x10 ⁻⁵	TDEC default	1x10 ⁻⁵	CWA default	1x10 ⁻⁵	Within SF acceptable risk range (10 ⁻⁴ to 10 ⁻⁶)
Exposure Duration – Fish (EDf), years	30	Discontinued CERCLA default	70	CWA default	26	SF default; rationale based on 20-year landfill life cycle
Fish Ingestion Rate (FIR), grams/year	170	Professional Judgement; 1 single 6-oz fish meal per year	8,030 (8-oz meal; 227 g/meal; equivalent to 34 meals/year)	CWA default	2,500 (8-oz meal; 227 g/meal; equivalent to 11 meals/year)	SF site-specific (no SF default for recreational use)

Technical Aspects

- Evidence-based, scientific computational approach (total fish biomass)
 - 22 radionuclides were selected based on waste stream for existing and new landfill
 - Fish tissue data collection to determine baseline/existing risk
 - # Edible fish (defined as >30 grams wet weight)
- Follows standard CERCLA risk assessment protocols
 - Accounts for radionuclide parent and key daughters/progeny. CWA and OW does not include radionuclide progeny.
 - Robust fish tissue data sets (Spring 2021 fish sampling + last 5-YR biomonitoring)
 - Not a negotiated estimate and does not consider LUCs, posted signage, proximity to more favorable fishery or angling in other fisheries
- Applies information from several credible sources of information
 - Spring 2021 fish tissue sampling & fish community survey (EPA approved Work Plan)
 - Last 5 years (2016-2020) of fish counts & total biomass at the nearest stream reach location
 - TN Wildlife Resource Agency's (TWRA) Melton Hill Creel Survey Report (TWRA 2019)
 - TDEC's Roving Creel Study (ongoing; anticipated completion is late 2022)
 - Burger et al. (2008) fish consumption study along the Clinch River arm of Watts Bar Reservoir adjacent to ORR

Fish Sampling Design

- Three points of exposure (stream reach locations) identified based on observed fishing activity, access to creek or other evidence of fishing
 - **BCK 3.3 – 4.5** (nearest stream reach to point of discharge)
 - **BCK 0.5 – 1.5** (mid-point location in Bear Creek)
 - **EFK 0.0 – 1.0** (furthest downstream location at the confluence of East Fork Poplar Creek and Poplar Creek)
- **EFK 0.0-1.0** included in sampling to help bound any radionuclide risk in Bear Creek, but not factored in fish meals calculation
- Electrofishing technique – captured most fish with multiple passes
 - Tissue from some smaller fish (<30 grams) used to make up biomass needed for radionuclide analysis



LEGEND:

-EXISTING STRUCTURE
-PRIMARY ROAD
-RIVER OR CREEK
-TRIBUTARY STREAM
-DOE BOUNDARY
-HIKING TRAIL (FOOT AND BIKES)
-LEASED PARCELS
-GREENWAY AREAS
-BEAR CREEK AND EAST FORK KILOMETERS
-BIOLOGICAL MONITORING LOCATION
-APPROXIMATE FISH SAMPLING REACHES
-TPGF.....TN PARKS AND GREENWAY FOUNDATION

OR ADMIN GRID
TRUE NORTH
34°13'±

UCOR
an Amentum-led partnership with Jacobs

FISH TISSUE SAMPLING AND FISH POPULATION SURVEY LOCATIONS LOCATION MAP - OAK RIDGE, TN

SOURCES: Oak Ridge Environmental Information System (OREIS)			
DRAWN BY: R. BEELER	REQUESTOR: A. PRIMROSE	DATE: May 19, 2021	UNITS: FEET
GIS FILE: P:\21001\MXDS\B85_FISH_SAMP-01_R1.mxd			

Fish Community Survey Results

- Spring 2021 fish counts and biomass
- Similar fish density and biomass in Bear Creek and reference location (BFK)

Stream Reach Location	Fish Counts	Total Weight of Edible Fish (>30 grams)	Notes
BCK 3.3 – 4.5	1 (shallow depths; habitat most suitable for smaller sized fish (e.g., sunfish))	38	Supplemented fish count with last 5-year BMAP data, which increased fish population to 27 and total edible biomass to 99.2 grams (95 th upper percentile)
BCK 0.5 – 1.5	12	682	
EFK 0.0 – 1.0	25	1,780	
BFK 7.6	10	652	Background reference location

Key Inputs in Fish Meals Calculation

- **Fish count** (considerations for weight and length-to-weight ratio; edible fish defined as >30 grams wet weight)
- **Total Biomass** – stream reach specific
- **Exposure duration** – 26 years
- **Number of fishing trips** – 30 fishing trips [Melton Hill creel data; 4 fishing trips per month over 6 months (late Spring, Summer and Fall) and 2 trips per month over three months]
- **Edible fish proportion (fish yield)** – 50% (upper end for fish yield; literature-based value; average yield ranges from 28-50%)
- **Fish catch effort** – 7 fish per hour (unaffected by fish density)
- **Fish catch success rate** (expressed as a percentage) – stream reach specific

Catch Success Rate Extrapolation

- A measure of fishing success (catch per unit of fishing effort)
 - A key determining factor in number of fish meals at a given stream reach location
 - A function of catch effort and total biomass

$$\text{Total catch} = \text{Total effort} \times \text{Average catch rate}$$

Hoenig J.M. et al. 1997. *Calculation of Catch Rate and Total Catch in Roving Surveys of Anglers, Biometrics* 53:306-317 (March 1997)

- 2019 TWRA Creel Survey Report for Melton Hill used as a conservative measure of fishing effort in a day
 - Catch Range per hour over a 6-hour fishing trip (Melton Hill) = 0.14 - 2.05 catch per hour
 - 95% Upper Confidence Limit on the Mean = 1.213 catch per hour

$$\begin{aligned} \# \text{ Fish Caught (per hour)} &= 1.213 \text{ fish per hour} \times 6 \text{ hours} \\ &= 7.28 \text{ fish per fishing trip} \end{aligned}$$

Catch Success Rate Extrapolation (cont'd)

For BCK 0.5 – 1.5:

- **Fish Catch Success Percentage** = Fish catch per hour / Total Fish Count (TWRA 2019)

= 7 fish catch per hour / 12 total fish x 100%

= 58% fish catch per trip

- **Annual Fish Catch (in grams/year)** = Edible fish biomass (g/yr) x Average Fish Catch Success Percentage for BCK (BCK 3.3-4.5 and BCK 0.5-1.5) (%) x Total # Fishing Trips

= 341 grams/year x 0.43 x 30 fishing trips/year

= 4,400 grams/year

- **Number of Fish Meals (per year)** = Total Biomass / Biomass per fish

= 4,400 grams/year / 227 grams/meal

= 19.3 fish meals/year

Number of Fish Meals

= 2.8 fish meals/year

Wrap-Up

- Contrary to DOE's claim, sizable and edible fish are present in Bear Creek.
- Three-fold difference in fish meal estimate for CERCLA (2,500 g/yr) versus CWA (8,030 g/yr) methods
- 11 fish meal estimate is within the CERCLA risk range for 22 radionuclides
- Region 4 methodology includes radionuclide parent and key progeny/daughters consistent with the waste stream
- Total biomass and species density for Bear Creek is within the range of measurements observed by the BMAP for Brushy Fork creek and two other reference locations
- Spring 2021 fish tissue data shows no statistically significant difference in concentrations when compared to fish tissue data in the study's reference location (BFK)
- No detectable radionuclides in fish tissue reported above the target fish tissue Preliminary Remediation Goals ($TR = 10^{-5}$)

Questions

Additional information (12-01-2021)

- The 22 radionuclides of concern are Atomic Energy Act (AEA) materials; they are byproducts of nuclear fission.
- Several of the radionuclides of concern are unique to nuclear fission and are not generally present in the environment, including Technetium-99, Europium-154, Plutonium-238, Plutonium-239, Neptunium-237, Cobalt-60, Cesium-137 and Strontium-90.
- Several of the radionuclides of concern have relatively short half-lives and would not be expected to persist in the environment beyond the 26-year exposure duration.